

## Review Article

# Role of Thermal Therapies in Sports Injuries

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### Article Info

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### **Introduction**

Physiotherapy is the treatment measure of physical and electrical means to accelerate the patient's recovery from injuries and diseases that hazards the normal life style.

### **Abstract:**

Sports injuries are injuries related to sports and exercise. They can result from acute trauma or from over use of a particular body part. When soft tissue experiences trauma, the dead and damaged cells release chemicals which initiate an inflammatory response. The inflammatory stage is therefore the first phase of healing. However, too much of an inflammatory response in the early stage can cause the healing process to take longer and return to activity delayed. Sports injury treatments are intended to minimize the inflammatory phase of an injury, so that the overall healing process is accelerated. Applied appropriately, thermal modalities can be helpful adjuncts to soft tissue manipulation.

To use thermal modalities effectively requires the practitioner to understand the few fundamental principles of physics and physiology in the body, such as the nature of the pain, methods of heat transfer and the physiological responses to temperature change. The thermal agents such as the Ice bags, hot packs or ultra sound units are used to increase circulation and soft tissue extensibility, increase or decrease local tissue metabolic rate and to decrease inflammation. In addition, a primary purpose for using thermal modalities in the rehabilitation environment is pain management.

**Keywords:** Sports injury, thermal therapy, inflammatory response, pain management, Ice bags, hot packs or ultra sound

In a broader sense, Physiotherapy means a physiotherapeutic system of medicine, which includes examination, treatment, advice and instruction to any person preparatory to or for the purpose of

in connection with movement dysfunction, bodily malfunction, physical disorder, disability in healing and pain from trauma and disease, physical and mental conditions using physical agents, using exercises, mobilization, manipulation, mechanical and electrotherapy activity and devices or diagnosis treatment and prevention. In physiotherapy heat, electric current, water, massage and exercises with or without resistance are utilized [1]. The thermal modalities which include both heat and cold is therefore one of the important component in physiotherapy. Both heat and cold can be effective forms of treatment especially to manage pain, stiffness, oedema and spasticity. The thermal modalities, based on their physical and physiological effects and mode of application have been studied here.

### Heat Modalities

Heat is one of the important modalities used in physiotherapy. Heat has been used to manage pain for as long as man has had access to specific usable sources such as hot springs and pools, hot rocks, or simply wrapping parts in blankets [2]. There are principally three methods by which heat is transferred to tissues from a therapeutic source. They are conduction, convection and thermal radiation. Conduction mechanism is one in which the energy gets transferred between two regions which are at different temperature. It occurs due to the collision of molecules. The energy transfers from one molecule to the adjacent molecules due to increase in its vibration. Application of hot pack to the skin surface induces skin warming by heat conduction. Heat transfer in convection mechanism is by the movements of the molecules, which occurs mainly in fluids. When the fluid is heated, the kinetic energy of that part is increased and those molecules travel apart and the part becomes less dense. Following this, the less kinetic energy molecules

replace those displaced molecules. In thermal radiation, heat is transmitted as electromagnetic radiation, which is emitted by the hot body surface or the body in which temperature is not absolute zero. Here the electromagnetic radiation is released from an atom when an electron moves to its own shell from a higher energy shell. Those radiations occur primarily in the infrared bands of wavelength about  $10^5$  cm to  $10^2$  cm [3]. The transfer of heat from one body to another depends on several factors [4]. Some of the most important of these are the relative masses of the bodies, the size of the contact area, the difference in starting temperatures, the heat capacity of each material, and in the case of cryotherapy, rewarming of the tissue from its own metabolic activity and from perfusion. One the energy is absorbed; it is immaterial as to how the heat was delivered. There are no different heats, only different means of generating the same heat [5].

### Physical effects of heat

When heat is applied to any surface or fluid then a number of physical phenomenon results from rise in its kinetic energy, such as:-

1. Rise in temperature: Due to heating, the average kinetic energy of the molecules of that surface is increased.
2. Expansion of the material: Increase in kinetic energy produces a greater vibration of molecules and they move further apart and expand the material.
3. Reduction of viscosity of fluid: Dynamic viscosity is one of the properties of fluid. The molecules in viscous fluid are quite strongly attached to each other but when the fluid is heated it results in increased kinetic energy of the

molecules, due to this it reduces the cohesive neutral attraction of the molecules making the fluid less viscous .

The therapeutic effects of the locally applied heat are-

1. Pain relief.
2. Muscle relaxation.
3. Increased blood flow.
4. Increased rate of tissue healing.
5. Increases the extensibility of tissue.

**1 .Pain relief:**

Heat is often used to relieve pain. Various mechanisms may be responsible. Pain may be relieved by reducing secondary muscle spasm and increasing circulation to ischemic muscle. Heat can also be claimed to act as a ‘counterirritant’. Changes in nerve conduction velocity may also be a factor. Heat has secondary pain-relieving effects as the vasodilatation accelerates the removal of pain-inducing metabolites or inflammatory products and so reduces congestion.

**2. Muscle relaxation:**

Heating to temperature of between 40 and 45<sup>0</sup>C results in reduction of muscle spasm. Increased tone associated with upper motor neuron lesions can be reduced to some degree by heating.

**3. Increased blood flow:**

Heat reduces viscosity of blood and leads to vasodilatation. Vasodilatation may be due to: (1) a direct effect on the smooth muscles of arterioles and venules; (2) a local axon reflex; and (3) increased level of certain metabolites in blood.

**4. Increased rate of tissue healing:**

An increase in blood flow means that there are likely to be a greater number of WBCs and more nutrients available for the healing

process. Haemoglobin releases twice as much oxygen at 41<sup>0</sup>C than at 36<sup>0</sup>C, and releases it twice as quickly.

**5. Increases the extensibility of collagen fibres:**

By application of heat, the collagen fibres become soft and at the same time will follow a passive or active stretching. A temperature of 39<sup>0</sup>C relates to the transition phase of collagen. When a permanent elongation is required, such as to mobilize a stiff joint, a raised temperature of over 39<sup>0</sup>C is needed.

**Heat modalities**

Primary mode of heat transfer	Modalities
Conduction	Hot pack Paraffin wax
Convection	Fluid therapy Hydrotherapy Moist heat
Radiation	Radiant heat Infra-red Ultra-violet Short wave diathermy Micro wave diathermy Laser

**Cold Modalities**

Cold is one of the thermal modalities used in physiotherapy. Cryotherapy means application of cold to tissues, resulting in the cooling of that part by transfer of heat energy from the part to the cooling medium. Cryotherapy is the most commonly used modality in the acute management of musculoskeletal injuries [6]. The primary rationale for this use of cold involves the demonstrated ability of cold to reduce the metabolic rate of a tissue [7]. This metabolic reduction may allow an otherwise uninjured tissue to survive a post injury period of ischemia

or be protected from damaging enzymatic reactions that may accompany injury [8]. The media usually used are ice, cold packs and chilled water. Ice is used more frequently than cold water because the ice cools the injured part faster by taking latent heat from the body, which melts the ice.

### **Cryotherapy thermodynamics**

Brief background information on the thermodynamics of cryotherapy is needed to understand its mode of action. First and most importantly, heat transfer is always unidirectional from high heat to low heat[9]. Therefore, cryotherapy modalities do not transfer cold to the tissues because cold is not transferable. Instead, tissues warm the cold modalities by losing heat to them. Although this may seem like a matter of semantics, it actually has some important implications for the efficacy of cryotherapy. Because heat transfer is unidirectional, cold modalities work by absorbing heat from their immediate environment, particularly from the tissues being treated. Similarly, deep tissues are cooled by losing their heat to more superficial tissues, which have been cooled by the modalities. The transfer of heat and the capacity of the cold modality to absorb this heat are therefore paramount in determining the modality's effectiveness.

### **Physiological effects of cold**

#### **1. Reduction in swelling and inflammation:**

This occurs due to the fast vasoconstriction of the blood vessels of that area, which decrease blood circulation to injured area leading to reduction in extravasations of fluid into the interstitial space. The decreased blood supply also leads to reduction in inflammation.

#### **2. Pain relief:**

The reduction in pain that accompanies cooling can be due to either direct or indirect factors. (1) Direct factor: Cold applied to skin initially stimulates both cold and pain sensations. If the cold is sufficiently intense, both sensations are suppressed because of inhibition of nerve conduction. (2) Indirect factor: Pain reduction due to reduction in swelling and muscle spasm.

#### **3. Reduction in muscle spasm:**

Although the underlying physiology is not totally known, cold can reduce muscle tone. Muscle spindles respond more rapidly than other neural and muscular structures as the reduction in temperatures required for activation are not so great. With reduced temperatures, muscle spindle sensitivity drops in proportion to the degree of cooling, possibly as a result of a direct effect on the sensory terminal, or as the firing rate of Ia afferents is decreased, or both.

#### **4. Limiting the extent of initial injury:**

This happens due to vasoconstriction, which occurs due to application of cold, leading to reduction in metabolic activities and oxygen demand of the injured tissues.

### **Modes of applications**

1. Ice massage
2. Immersions
3. Ice packs
4. Evaporation cooling

### **Contraindications for Heat Therapy**

- Lack of local thermal sensitivity on the part of the patient
- Local areas of recent bleeding
- Devalitized skin, eg. after deep X-ray treatment
- Certain skin conditions, eg. skin carcinomas, acute dermatitis
- Impaired local circulation

- Damaged or infected tissues: moist heat may encourage breakdown.

### **Contraindications for Cold Therapy**

Circulatory disorders – coronary heart diseases.

External haemorrhage.

Patients with allergy to cold.

### **Discussion**

Many of the clinical benefits produced by heat and cold are similar. Selection is therefore based on a number of factors. Generally, cold is preferable during the acute stage of inflammation to relieve pain, reduce the level of bleeding and swelling and possibly retard secondary injury following trauma. Heat, in contrast, can exacerbate the early inflammatory process. Heat tends to increase oedema whereas cold can help to limit it in recent injuries. A rise in temperature increases collagen extensibility, whereas it becomes stiffer with cold. Both heat and cold can be used to relieve pain. The effect of cold may be more prolonged but in certain situations can cause or increase pain. Both heat and cold can decrease muscle spasm associated with musculoskeletal injuries, upper motor neuron dysfunction and nerve root irritation. But heat will do so for only a short period of time; cold is generally more effective as the return to normal temperatures takes longer period. There appears to be a slight increase in the power of contraction with a rise in temperature between 25-37<sup>0</sup>C, whereas cooling below this leads to a decrease. In some subjects, the application of cold to hands and feet leads to severe pain and this may therefore be an indication for heat therapy. A second important factor to be considered when selecting thermal treatment is that of choosing between wet and dry contact techniques. The dry heat can elevate surface temperature to a

slightly greater degree, whereas wet heat can lead to rises in temperature at slightly deeper level. Thus, either can be used for closed injuries. Wet techniques have the potential to introduce infection into an open wound and to waterlog tissue. Commonly in contrast bath method, heat and cold can be used alternatively. Cold modalities with different thermodynamic properties do, in fact, produce different IM temperatures during cryotherapy. Ice-based modalities go through a change of state from solid to liquid and as a result absorb substantially more heat. This increased heat absorption resulted in colder IM temperatures than were observed with gel packs. Therefore, use of cold modalities that go through a change in physical state (ie, ice-based modalities) over other cold modalities in the management of musculoskeletal injuries [10].

### **Conclusion**

Injuries happening in sports are not uncommon. Sports medicine aims at treatment and prevention of sports injuries. Physiotherapy is integral parts of sports medicines which aims at returning an injured athlete quickly and safely back his or her sport. Thermal modalities can be either heat or cold, which are used in physiotherapy. Selection between heat or cold modalities depend on certain factors like nature and stage of injury, area to be treated, ease of use, patient preference and specific contraindications. Generally in acute injuries it is preferable to use cold modalities than heat modalities as heat can worsen the condition by increasing inflammation or oedema. Cold modalities when used as first aid are preferably used along with compression. Beneficial effects of heat are seen more in the later stages of injury, possibly being of

greatest use for chronic injuries with delayed repair.

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### References

1. R.N. Goel, Goel's Physiotherapy. Shubham Publication, 3rd ed.,2004, Pp1.
2. Sheila Kitchen, Electrotherapy: Evidence-based Practice. Reed Elsevier India Private Ltd, 12th ed.,2002,pp125-35.
3. R.N. Goel, Goel's Physiotherapy. Shubham Publication, 3rd ed.,2004, Pp 571-9.
4. Halliday D, Resnick R. Fundamentals of Physics. John Wiley & Sons, 3rd ed.,1988,pp446-55.
5. Sheila Kitchen, Electrotherapy:Evidence-based Practice. Reed Elsevier India Private Ltd, 11th ed.,1999,pp105-12.
6. Merrick MA, Knight KL, Ingersoll CD, Potteiger JA." The effects of ice and compression wraps on intramuscular temperatures at various depths" . J AthlTrain, vol.29,pp236 –245,1993.
7. Guyton AC. Textbook of Medical Physiology. WB Saunders, 8th ed., 1991,pp 345-7.
8. Knight KL." Effects of hypothermia on inflammation and swelling" . Athl Train JNatl Athl Train Assoc. Vol.11,pp7-10,1976.
9. Lide D, CRC Handbook of Chemistry and Physics. Boca Raton, FL: CRC Press, 74th ed., 1994:5.1–5.17.
10. Mark A. Merrick, Lisa . Jutte, Michael E. Smith. "Cold Modalities with different thermodynamic properties produce different surface and intramuscular temperatures" . J